REMARKS

The Applicants sincerely appreciate the thorough examination of the present application as evidenced by the Office Actions of February 14, 2005, April 18, 2005, and August 26, 2005. In response, the Applicants have rewritten Claim 4 in independent form including all recitations of Claim 1 and 42 and clarifying that the thermal process is performed while the second conductive layer remains exposed; rewritten Claim 18 in independent form including all recitations of Claims 15 and 43 and clarifying that the thermal process is performed while the second conductive layer remains exposed; and canceled Claims 1, 15, and 33-44.

In the following remarks, the Applicants will show that all claims are patentable over the cited art. A Notice of Allowance is thus respectfully requested in due course. In the alternative, the Applicants request entry of this amendment as narrowing issues for further consideration on appeal.

All Rejections Under 35 U.S.C. Sec. 112 Have Been Overcome

The Final Office Action has objected to Claims 42, 43, and 44, stating that the language "performing a thermal process" should be amended to "performing the thermal process". As discussed above, Claims 42-44 have been canceled. Accordingly, all rejections under 35 U.S.C. Sec. 112 have been overcome.

I. Claims 4 and 18 Are Patentable Over The Cited Art

Claims 4 and 18 have been rejected under 35 U.S.C. Sec. 103(a) as being unpatentable over Applicant's admitted prior art (AAPA) in view of U.S. Patent No. 6,475,854 to Narwankar et al. ("Narwankar"). Claim 4 and 18 have also been rejected under 35 U.S.C. Sec. 103(a) as being unpatentable over AAPA in view of U.S. Patent Application No. 2003/0107076 to Lin et al. ("Lin"). The Applicants respectfully submit that Claims 4 and 18 are patentable over the cited art for at least the reasons discussed below.

Claim 4, for example, has been rewritten in independent form, and Claim 4 thus recites a method for fabricating a semiconductor device, the method including:

> forming a first conductive layer for a first electrode on a semiconductor substrate;
> forming a dielectric layer on the first conductive layer;
> forming a second conductive layer for a second electrode on the dielectric layer;

after forming the dielectric layer and after forming the second conductive layer, removing portions of the second conductive layer and portions of the dielectric layer thereby exposing portions of the first conductive layer previously covered by the dielectric layer; and

after removing portions of the second conductive layer and portions of the dielectric layer, performing a thermal process on the second conductive layer and the dielectric layer at a temperature of at least about 400°C while the second conductive layer remains exposed wherein the performing the thermal process comprises heating the dielectric layer and the second conductive layer at a temperature in the range of about 450°C to 600°C in an inert gas atmosphere.

Claim 18 includes similar recitations.

A. Claims 4 and 18 Patentable Over The Combination Of AAPA And Narwankar

The Final Office Action concedes that AAPA "does not disclose the method wherein the performing the thermal process comprises heating the dielectric layer and the second conductive layer at a temperature in the range of about 450EC to 600EC in an inert gas atmosphere." Final Office Action, page 6. In support of the rejection, the Final Office Action states that:

> Narwankar et al. disclose the method wherein the performing the thermal process comprises heating the dielectric and the second conductive layer at a temperature in the range of about 450EC to 600EC in an oxygen atmosphere or an inert gas atmosphere (see column 15, lines 55-60, column 11, lines 4-10, and column 9, lines 10-24 and Table 1).
>
> It would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the thermal process of AAPA by the method of Narwankar et al. because as Narwankar et al. teaches while annealing the top electrode and dielectric, a pure oxygen atmosphere is interchangeable with an atmosphere with inert gas (see Table 1) and that the annealing allows for incorporation of oxygen within the electrode which provides for improved performance of the capacitor (see column 1,, lines 5-15 and column 15, lines 35-55).

Final Office Action, page 6.

The Applicants respectfully submit that Narwankar also fails to teach or suggest heating the dielectric layer and the second conductive layer at a temperature in the range of about 450EC to 600EC in an inert gas atmosphere after removing portions of the second conductive layer and the dielectric layer. In particular, Table 1 of Narwankar sets forth conditions of the "Top electrode anneal" at column 13, lines 5-20. More particularly, Table 1 sets forth a parameter range of ambient conditions for the top electrode anneal as "Inert/oxygen mixture, 100% oxygen" (underline added) and a preferred value range of "4:1:0.1 $Ar:O_2:N_2$". *See*, Narwankar,

col. 13, lines 13-15. Accordingly, Table 1 of Narwankar fails to teach or suggest a thermal process in an inert gas atmosphere after forming a second electrode, much less a thermal process in an inert gas atmosphere after removing portions of a second electrode and a dielectric layer. Instead, Narwankar discusses an "inert/oxygen mixture" or "100% oxygen" used to anneal the top electrode. With respect to Figure 9h, Narwankar discusses "depositing a first Ru layer (not shown) on the insulator layer **912**, followed by an annealing in an oxygen-containing ambient." Narwankar, col. 15, lines 43-45.

Moreover, the Applicants note that Table 1 of Narwankar discusses an "Inert or oxygen contaning environment" for bottom electrode deposition (*see*, col. 12, lines 13-14), an "Inert, inert/oxygen, 100% oxygen" ambient for insulator anneal (*see*, col. 12, lines 44-45), and an "Inert or oxygen-containing environment" for top electrode deposition. Nothing in Table 1 or any other portion of Narwankar, however, teaches or suggests that inert and oxygen containing environments are interchangeable for the top electrode anneal of Narwankar. In fact, Narwankar specifically states that the ambient for the top electrode anneal is an "Inert/oxygen mixture, 100% oxygen." Narwankar, col. 13, lines 13-15 (underline added). Accordingly, Narwankar teaches away from heating the dielectric layer and the second conductive layer in an inert gas atmosphere.

As set forth in the Manuel Of Patent Examining Procedure (MPEP) to establish a *prima facia* case of obviousness, the prior art references when combined must teach or suggest all the claim limitations. MPEP, Sec. 2143. As discussed above, neither AAPA or Narwankar, taken alone or in combination teaches or suggests heating the dielectric layer and the second conductive layer in an inert gas atmosphere after removing portions of the second conductive layer and the dielectric layer (and thus after forming the second conductive layer). For at least the reasons discussed above, the Applicants respectfully submit that Claim 4 is patentable over the combination of AAPA and Narwankar.

B. Claim 4 Is Patentable Over The Combination Of AAPA And Lin

The Final Office Action concedes that AAPA "does not disclose the method wherein the performing the thermal process comprises heating the dielectric layer and the second conductive layer at a temperature in the range of about 450EC to 600EC in an inert gas atmosphere." Final Office Action, page 6. In support of the rejection, the Final Office Action states that:

> Lin et al. disclose the method wherein the performing the thermal process comprises heating the dielectric layer and the second conductive layer at a temperature in the range of about 450EC to 600EC in an oxygen atmosphere or an inert gas atmosphere (see [0098])
>
> It would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the thermal process of AAPA by the method of Lin et al. because as Lin et al. teaches the method reduces the damage to the capacitors in the back end process before interconnections are made (see [0098]).

Final Office Action, page 8.

As shown, in Figure 16 of Lin, the plate electrode **88** is covered by the TiN film **82**, the insulation film **84**, the insulation film **90**, and the plug **96** before the thermal processing of paragraph [0098] cited by the Final Office Action. In particular, the cited portion of Lin states that:

> [0098] Then, thermal processing is performed in a forming gas atmosphere (3% H_2+97% N_2) and, e.g., at 400EC and for 1 hour. The thermal processing is followed by thermal processing in a nitrogen atmosphere and, e.g., at 500EC for 1 hour. The thermal processing can reduce damage to the capacitors in the back end process until the plugs **96, 98** have been formed, whereby characteristics of the capacitors can be improved.

Lin, paragraph 98. (Underline added.)

Accordingly, Lin fails to teach or suggest heating a dielectric layer and a second conductive layer in an inert gas atmosphere while the second conductive layer remains exposed. Moreover, Lin teaches away from the heating while the second conductive layer remains exposed because Lin discusses reducing damage by performing thermal processing after the plugs **96** and **98** have been formed. For at least the reasons discussed above, the Applicants respectfully submit that Claim 4 is patentable over the combination of AAPA and Lin.

II. Claims 2-14 And 16-23 Are Patentable

For at least the reasons discussed above, the Applicants respectfully submit that Claim 4 is patentable over AAPA, Narwankar, and Lin. In addition, Claim 18 is patentable for reasons similar to those discussed above with respect to Claim 4. Moreover, Dependent Claims 2-3, 5-14, 16-17, and 19-23 are patentable at least as per the patentability of Claims 1 and 15 from which they depend. Reinstatement and allowance of previously withdrawn Claims 2, 5-8, 16-17, and 19-20 is respectfully requested as these claims depend from allowable independent claims.

CONCLUSION

Accordingly, the Applicants submit that all pending claims in the present application are in condition for allowance, and a Notice of Allowance is respectfully requested in due course. The Examiner is encouraged to contact the undersigned attorney by telephone should any additional issues need to be addressed.

Respectfully submitted,

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